BULLETIN

OF THE INSTITUTE OF METALS

VOLUME 5 MARCH 1961 PART 19

INSTITUTE NEWS

Council: Election to Fill Vacancies in 1961–62

In accordance with the Institute's Articles of Association, some members of the Council retire at the Annual General Meeting each year. At the 1961 Annual General Meeting the following will retire: Sir RONALD PRAIN (*President*); Major C. J. P. BALL (*Past-President*); Mr. R. D. HAMER (*Vice-President*); and Professor J. W. CUTHBERTSON and Mr. F. WAINE (*Ordinary Members of Council*).

Under Article 19, Sir RONALD PRAIN, O.B.E., Hon.M.I.M.M., will fill the vacancy on the Council as Past-President.

The following members have been elected to fill the vacancies and will take office at the Annual General Meeting on 21 March 1960.

President:

Professor H. O'NEILL, M.Met., D.Sc., F.I.M., Head of the Department of Metallurgy, University College of Swansea, University of Wales.

Vice-Presidents:

Mr. W. F. RANDALL, B.Sc., A.R.S.M., M.I.E.E., F.I.M., Deputy Chairman, Telegraph Construction and Maintenance Co., Ltd., and Deputy Chairman and Managing Director, Telcon Metals, Ltd., Crawley.

The Right Hon. The Earl of VERULAM, Chairman, Enfield Rolling Mills, Ltd., Brimsdown, Middx.

Ordinary Members of Council:

Mr. N. I. BOND-WILLIAMS, B.Sc., F.I.M., Managing Director, Aston Chain and Hook Co., Ltd., Birmingham.

Professor A. H. COTTRELL, M.A., Ph.D., F.I.M., F.R.S., Goldsmiths' Professor of Metallurgy, University of Cambridge.

Mr. G. A. RIDER, F.C.W.A., Deputy Managing Director, Birmid Industries, Ltd., Birmingham.

Senior Vice-President for 1961–62

The Council has elected The Right Hon. The Earl of VERULAM to serve as Senior Vice-President for 1961–62, and he will be its nominee for the Presidency in 1962–63.

1961 May Lecture

The title of the May Lecture by Professor M. POLANYI, F.R.S., will be "Towards a Philosophy of Engineering". The lecture will be delivered at the Royal Institution, Albemarle Street, W.1, at 6.30 p.m. on Tuesday, 21 March.

Chairmen of Committees

The following Chairmen of Committees have been appointed by the Council for 1961–62:

Editorial Board: Dr. L. B. Hunt.
Finance and General Purposes Committee: Mr. W. F. Randall.
Library Committee: Dr. J. C. Chaston.
Local Sections Committee: Dr. N. P. Allen.
Metal Physics Committee: Mr. H. W. G. Hignett.
Metallurgical Engineering Committee: Professor H. Ford.
"*Metallurgical Reviews*" *Committee:* Professor R. W. K. Honeycombe.
Nuclear Energy Committee: Mr. L. Rotherham.
Publication Committee: Dr. H. M. Finniston.

Pre-Heating and Hot Rolling

An Instructional Meeting for Younger Members 12–15 April 1961

The third in the series of Instructional Meetings for Younger Members, arranged by the Metallurgical Engineering Committee, will take place at Cardiff between 12 and 15 April 1961. The subject for study will be "Pre-Heating and Hot Rolling", and Mr. T. W. Hood, of W. H. A. Robertson and Co., Ltd., and Mr. J. Rankine, of Alcan Industries, Ltd., have agreed to act as Directors of Studies. The intention of this series of meetings is to encourage the study of specific works problems, and the subject will be studied in detail by visits to works and the discussion of various aspects of it by individual syndicates.

Accommodation has been arranged at University Hall Cardiff, and those participating in the meeting must agree to reside there. Members will assemble for lunch on Wednesday, 12 April, and will disperse at noon on Saturday, 15 April. The full programme of the meeting, including the topics for syndicate study, is being circulated to all Junior and Student members. The Council wishes to emphasize that the purpose of the meeting is instructional, and that it is primarily intended to meet the needs of younger members in industry. The meeting is, however, open to any member and copies of the programme and registration form are available from the Secretary at the Institute's headquarters.

Joint Symposium on "Structural Processes in Creep"

The Iron and Steel Institute and The Institute of Metals are holding a joint symposium on "Structural Processes in Creep" on Wednesday and Thursday, 3 and 4 May 1961. The symposium will be held at the Hoare Memorial Hall, Church House, Great Smith Street, London, S.W.1. There will be three sessions: 2.30–4.30 p.m. on 3 May, and 10.0 a.m.–12.30 p.m. and 2.30–4.30 p.m. on 4 May.

Participation in the symposium is open to members of both Institutes. There is no registration fee, but those wishing to obtain preprints of the papers can do so only by ordering a bound volume of the proceedings of the symposium, which will be published by The Iron and Steel Institute later in 1961.

Full details of the symposium will be announced shortly, and programmes and registration forms will be circulated to members of both Institutes.

Conference on " The Metallurgy of Beryllium "

As announced in the November issue of the *Bulletin*, the Institute's Nuclear Energy Committee is organizing an international conference on " The Metallurgy of Beryllium ", which will be held in the Lecture Theatre of the Royal Commonwealth Society, Craven Street (near Northumberland Avenue), London, W.C.2, on Monday to Wednesday, 16–18 October 1961, inclusive.

More than 70 papers have been offered for this conference, the object of which is to print and discuss a great deal of unpublished original work on beryllium that has been carried out in recent years.

Because of the large number of papers offered, it has been arranged, provisionally, that they shall be presented for discussion, in groups, by rapporteurs at sessions that will cover the following general subjects:

(a) *Mechanical and physical properties* (covering pure metal preparation, deformation and fracture studies; effect of heat-treatment; texture in sheet; texture in tube; effect of grain size, &c.).

(b) *Use of beryllium in nuclear reactors* (corrosion; compatibility; irradiation properties, &c.).

(c) *Use of beryllium in missiles and aircraft.*

(d) *Metal preparation and fabrication* (ingot and powder; rolling; extrusion; forging; joining, &c.).

A registration fee will be charged to those who wish to receive the preprints of papers, to be issued prior to the meeting; the registration fee will cover the cost of a ticket for a cocktail party to be held on the evening of the first day of the conference. There will also be an informal dinner on 18 October, the cost of tickets for which will be additional to the registration fee.

Early in 1962 a bound volume will be published, containing papers and a report of the discussion at the conference. This book will be on general sale.

Copies of the programme of the conference, with registration forms, will be sent to members as soon as possible. Registration for the conference will be open to non-members as well as members of the Institute.

Engineering, Marine Welding, and Nuclear Energy Exhibition, London

The Engineering, Marine Welding, and Nuclear Energy Exhibition will be held at Olympia from 20 April to 4 May.

By invitation of the directors, the Institute will pay an official visit to the exhibition on Thursday, 27 April. Free tickets of admission to the exhibition for that day will be sent to all members in due course.

PERSONAL NOTES

Mr. P. H. Bowker has left the College of Aeronautics and joined the Development Division of Alcan Industries, Ltd., Banbury.

Mr. S. E. Clotworthy, Managing Director of Alcan Industries, Ltd., has been appointed Chairman of the Aluminium Industry Council.

Mr. J. C. Colquhoun has retired from the Chairmanship of The Manganese Bronze and Brass Co., Ltd.

Mr. S. Elstub has been elected Chairman of Amal Ltd., a subsidiary of Imperial Chemical Industries, Ltd.

Professor J. Neill Greenwood has retired from the Metallurgy School and the Baillieu Laboratory in the University of Melbourne. He has, however, been appointed to a personal Chair in the University for a further year and has been elected Dean of the Faculty of Science and Applied Science in the University.

Mr. P. Hoesli has resigned from the staff of the British Non-Ferrous Metals Research Association to take up an appointment as corrosion and metallurgical engineer at the head office of Shell Chemical Co., Ltd., London.

Mr. W. W. Kee has been appointed an additional director of Enfield Rolling Mills, Ltd.

M. Ch. Losman has been appointed Director of S. A. Usine à Métaux Alfred Molinet, Tirlemont, Belgium.

Mr. C. H. Meigh, Managing Director of Meigh Castings, Ltd., was awarded the M.B.E. in the New Year Honours List.

Mr. E. G. V. Newman, Principal Scientific Officer, Royal Mint, was awarded the O.B.E. in the New Year Honours List.

Mr. B. P. R. Parsons has been appointed Chairman of Bound Brook Bearings, Ltd., and a director of the parent company, Birfield Ltd.

Dr. B. P. Planner has left the service of the Armour Research Foundation and is now Consultant for, and European Representative of, the Universal Cyclops-Steel Corp., of Bridgeville, Pa. Dr. Planner is located at The Hague.

Mr. N. A. Ratcliff has left The British Aluminium Co., Ltd., Milton, and is now a research scientist in the Metallurgy Section of the A.E.I. Research Laboratory, Harlow.

Mr. D. F. Reardon is now Senior Technical Assistant to the Managing Director of Silver End Documentary Publications, Ltd.

Mr. J. W. Roberts has joined the staff of Clugston Cawood, Ltd., as foam plant manager at their North Lincoln slag works.

Mr. M. A. Scheil, Director of Metallurgical Research to the A. O. Smith Corp., Milwaukee, has been elected National Secretary of the American Society for Metals.

Mr. J. R. Wilson has been appointed a lecturer in the Department of Physical Metallurgy, University of Birmingham.

Deaths

The Editor regrets to announce the deaths of:

Mr. Otakar Jestrabek, Managing Director of Actid, Ltd., Blantyre, near Glasgow, on 16 September 1960.

Mr. Martin Littmann, Chairman of Balzers High Vacuum, Ltd., on 13 January 1961.

Dr. Paul Melchior on 12 November 1960, aged 64. Until his retirement in 1955 he was Director of the Department of Metals and Metal Construction at the Bundesanstalt für Materialprüfung, Berlin–Dahlem.

THE JOINT LIBRARY

On 24 June 1938, the Libraries of The Iron and Steel Institute and the Institute of Metals were amalgamated in a Joint Library, which is located at 4 Grosvenor Gardens, London, S.W.1 (telephone SLOane 0061) and is administered by The Iron and Steel Institute. There is a Joint Library Advisory Committee.

The Joint Library—which is operated in the interests of members of both Institutes, and of the industries with which they are connected—has a Reading Room and offices and adequate storage facilities. In view of the growth of the library, storage rooms, shelving space, and offices have recently been increased by the building of an extension, and the Reading Room has recently been re-floored and the furniture renovated.

The Library contains over thirty thousand volumes and about one thousand periodicals and transactions. It is one of the most important metallurgical libraries in the United Kingdom, and every effort is made to maintain it at a high standard. Most of the items are purchased or received by exchange, but the Library has also been fortunate in receiving many donations of books from members and friends. Notices of books received are published either in the *Journal of The Iron and Steel Institute* or, in the case of the Institute of Metals, in the bibliography section of *Metallurgical Abstracts*; members are invited to suggest additional titles for acquisition. Many of the books are on open access in the Library itself; the remainder, together with the files of periodicals, transactions, &c., are available on request. An author index to the books, pamphlets, &c., in the Library can be consulted by members.

The Reference Library and Reading Room are available for the use of members from 10 a.m. to 5 p.m. daily, from Monday to Friday, throughout the year with the exception of the usual statutory holidays and certain other days of which notice is given. Members resident in the United Kingdom may borrow books or periodicals from the Library with the exception of standard works of reference and works of exceptional historical interest which cannot easily be replaced. For obvious reasons, books cannot be sent on loan to members resident overseas, but the Librarian will supply to both British and overseas members photocopies or microfilm of any part of a work held in the Library or outside it, subject only to the usual declaration, in accordance with the Copyright Act, that it is required for purposes of study or research. There are no fees, beyond the cost of reproduction.

Books and periodicals (which may be despatched and returned by post, if desired) are initially lent for two weeks, but the Librarian will, on application, extend this period whenever possible. Books and periodicals which are not held in the Library can generally be obtained on loan from other sources, and the Librarian will be glad to provide this service on request.

The number of items borrowed by members has increased rapidly in recent years, but it is felt that even greater use would be made of this important service if it were more widely known.

Members are recommended to make the fullest use of the Library service in association with the *Metallurgical Abstracts* service, by applying for the loan of articles or books which may appear to have a bearing on their own work and interests.

Members should address requests for loans and such enquiries as the Librarian can be expected to deal with to the Joint Library, 4 Grosvenor Gardens, London, S.W.1 (telephone SLOane 0061), and not to the Institute's Headquarters.

LECTURES TO LOCAL SECTIONS AND ASSOCIATED SOCIETIES

Valency in Metals and Alloys

Professor G. V. Raynor (University of Birmingham) gave a lecture on " Valency in Metals and Alloys " to the South Wales Local Section on 6 December 1960.

The lecturer said that the close association between chemistry and the early development of metallurgy had resulted in the frequent use of the term " valency " in theoretical metallurgy. Confusion now existed, however, since the same term was used in metallurgical literature to convey different meanings. In the solid state, the term valency might be discussed in terms of the number of electrons per atom contributed to the conduction band of the metal or alloy, and for simple metals this was satisfactory and in accord with cohesive characteristics. Difficulties arose, however, in connection with transition metals, and these led to the ideas associated with the name of Pauling, based essentially upon considering " valency " in terms of the number of electrons per atom concerned in bonding. The variable valency of transition metals in solid solution was discussed, and some recent work that was intended to clarify the conditions under which such variability occurred presented.

Electron-Microscope Observations of Dislocations in Metals

At their meeting on 8 December 1960, members of the Sheffield Local Section heard a lecture on " Electron-Microscope Observations of Dislocations in Metals " by Dr. P. B. Hirsch (Cavendish Laboratory, Cambridge).

The lecturer began with a brief account of the contrast effects observed on transmission electron micrographs of thin metal foils. Recent examples of the application of the technique to the study of dislocations in metals were discussed. Thus, the results of Howie's studies on the dislocation distributions in single crystals of copper and copper–aluminium alloys were described, and it was shown how the distributions correlated with the variation of stacking-fault energy as measured directly by Howie and Swann from extended dislocation nodes. The lecturer stressed the use of the technique in correlating bulk measurements of physical properties with electron-miscroscope observations. In this way, for example, the energy released on annealing a fatigued metal could be correlated with the disappearance of dislocation loops. The technique could also be used to make dynamic observations in the microscope. Thus the activation energy for the process of climb could be determined directly by observing the rate of shrinkage of dislocation loops on a heating stage in the electron miscroscope. A short film of this climb process was shown. The lecture also included brief references to the application of the technique to other problems, for example, recrystallization, quenching, and dislocation interactions with precipitates.

Meteorites

In a lecture to the Oxford Local Section on 3 January 1961, Dr. H. J. Axon (University of Manchester) spoke about " Meteorites ".

He said that meteorites could be classified as stones, irons, or stony-irons. In general, the stones were cermet mixtures of more or less broken minerals in conjunction with fragments of metal, although a very few stones might show an unfragmented structure similar to that of igneous rock.

The large austenite crystal size of the iron suggested that the crystals were originally formed by slow cooling from the melt, although the variety of detailed microstructure in samples of approximately the same composition suggested that the samples might have been subject to various cosmic heat-treatments before reaching the earth.

Some at least of the stony-irons might be regarded as slag–metal mixtures which had solidified in a low gravitational field, although other stony-irons had obviously cermet structures with a greater amount of metal than was encountered in the so-called stones.

Work in Manchester had been restricted to the irons, and particular attention had been paid to the effects of thermal metamorphism, either of the deep-seated type that might arise from such cosmic sources as passage near the Sun, or of the superficial alteration that arose from frictional heating in the Earth's atmosphere.

Evidence of superficial heat alteration had been obtained in a variety of specimens which at first sight appeared too badly corroded to make such a search profitable. Such results gave a rough guide to the extent of terrestial corrosion which the specimens had undergone since falling.

The more deep-seated cosmic metamorphism could be illustrated by a sequence of specimens such as the octahedrites Carlton, Boogaldi, and Huizopa, of which the latter two could be explained as progressively more highly altered versions of the basic structure shown by Carlton. It seemed likely that a detailed metallographic study of other octahedrites would reveal further evidence of metamorphism. This was important in so far as some investigators had tended to assume that thermal metamorphism was present only in irons of low or high nickel content, but not in the intermediate range corresponding to octahedrites. A clue to the relative stability of the octahedrites might lie in their relatively gross macrostructure and the low rate of intermetallic diffusion in austenite.

Metallurgy in Electronics

At a meeting of the London Local Section on 5 January 1961, Dr. J. E. Hughes, of the Associated Electrical Industries Research Laboratory, Harlow, gave a lecture on " Metallurgy in Electronics ".

He said that electronics was a rapidly growing science, with new devices and techniques being evolved continuously. These demanded the application of a wide variety of metals and alloys, and in fact almost all the metallic elements, including some rare-earth metals, were used. A number of the more unusual applications were described with reference to valves, light amplifier tubes, transistors, switches, &c.

Having surveyed the field in a general way, the lecturer then directed attention towards the detailed metallurgy involved in semi-conducting devices, in magnetostrictive delay lines, and in thermionic emitters for cathodes.

Metallurgical aspects of semiconductors were described, and it was shown that band-theory concepts could be invoked to explain how rectifiers and transistors worked. The stages in the manufacture of germanium alloyed junction transistors were illustrated, including crystal growth, zone refining, wafer preparation, and alloying with subsequent epitaxial regrowth processes to form p–n junctions. Future developments, embodying diffusion-based semiconductor devices, were also described.

The use of magnetic alloys in electronics was illustrated by reference to magnetostrictive delay lines used in computors and electronic telephone exchanges. These lines were used as acoustic wave storage elements and depended for their operation on the low velocity of sound through the alloy compared with the speed of functioning of electronic circuits. A number of rigid requirements had to be met in order to obtain satisfactory delay characteristics: these included high magnetostriction, high permeability, low pulse dispersion, and a constant value of elasticity modulus with temperature.

The emission of electrons from metals was then described in the context of valve cathodes. It was shown how the work function and operating temperature depended upon whether the cathode was a pure metal, a metal with monatomic surface films, or a metal coated with thick oxides. The metallurgical requirements of a nickel alloy substrate for indirectly heated barium oxide cathodes were described, and it was shown how levels of impurity in the range of parts per ten thousand could exert a considerable influence upon cathode performance.

In conclusion it was stressed that, although the illustrations had concentrated on some of the more unusual metallic properties, great reliance was still placed upon the traditional advantages of metals such as ease of fabrication, strength, and toughness.

Beryllium

At a meeting of the Birmingham Local Section on 8 December 1960, a lecture on " Beryllium " was given by Mr. J. Williams (Metallurgy Division, Atomic Energy Research Establishment, Harwell).

The history of beryllium was first outlined and attention drawn to those physical properties of the metal that made it of interest as a structural material. Thermal-reduction and electrolytic methods of extraction were briefly discussed, together with refining treatments for the products of these processes. Practical difficulties that had arisen in the casting of beryllium were mentioned. The improved mechanical properties of powder-metallurgical products compared with cast metal were the major reason for the present dominance of these former fabrication techniques. Every conventional method of powder fabrication had been used for beryllium, and many new ones had been developed specifically for use with this metal. Joining of beryllium was not easy, but a variety of techniques were now available, depending upon the properties required in the joint.

The deformation and fracture characteristics of single-crystal beryllium were outlined, particular emphasis being laid on the anisotropy of plastic properties which was largely responsible for the low ductility at room temperature of beryllium. Because of this anisotropy the nature of the textures developed in mechanically worked beryllium largely determined their mechanical properties. The development of textures in rods, tubes, and sheets was described, and it was pointed out that an extra high-temperature deformation mode, as yet unidentified, was needed to explain some results. Mechanical properties of fabricated beryllium at both room and elevated temperatures were discussed in terms of texture and single-crystal behaviour.

Emphasis was laid on the ease with which beryllium surfaces could be damaged and on the need for surface treatments if the best room-temperature properties were to be developed. Special attention was drawn to the inconsistency of mechanical properties in fabricated beryllium.

On the question of the effect of impurities on the ductility of beryllium, it was pointed out that workers on both sides of the Atlantic had demonstrated that improvements could be effected in the mechanical properties of certain types of commercial beryllium by heat-treatment. Very pure beryllium was now being prepared on a laboratory scale, but so far there was no evidence of striking improvement in room-temperature ductility as a result of such purification.

POWDER METALLURGY JOINT GROUP

Meetings in 1961

Members are requested to note the following dates arranged for meetings of the Joint Group in 1961:

Monday and Tuesday, 17 and 18 April, at the Royal Commonwealth Society, Craven Street (near Northumberland Avenue), London, W.C.2. Discussion on " The Appraisal of Powders for Pressing and Sintering ". The afternoon of 17 April will be devoted to the presentation and discussion of two review papers and two other papers under the general heading " Techniques for the Evaluation of Powders ". The subject to be discussed at the morning and afternoon sessions on 18 April will be " The Relationship Between Powders and their Pressing and Sintering Behaviour ". The papers will be printed in advance of the meeting in *Powder Metallurgy*, 1961, No. 7. A detailed programme will be sent to all Group members.

Thursday and Friday, 7 and 8 December, at Church House, Great Smith Street, London, S.W.1. A Symposium on "Sintered High-Temperature Oxidation-Resistant Materials". Offers of original papers for this meeting should be sent (with synopses if possible) as early as possible to The Secretary, Powder Metallurgy Joint Group, 17 Belgrave Square, London, S.W.1. Papers for this meeting will be printed in *Powder Metallurgy*, 1961, No. 8, to be published in November.

" Powder Metallurgy "

Members are reminded that the fee (10*s*. or $1.85 per annum, post free) for *Powder Metallurgy* for 1961 is now due for payment. Non-members may obtain *Powder Metallurgy* for an annual subscription of 25*s*. or $3.80, post free.

OTHER NEWS

Symposium on " Metallurgical Applications of Electron Bombardment "

It is announced that the Société Française des Ingénieurs et Techniciens du Vide will hold an international symposium on 21 April 1961 in Paris on " Applications métallurgiques du bombardement electronique ".

Further particulars may be obtained from Madame J. Mainier, Secrétariat Administratif: 147 ter A, Boulevard de Strasbourg, Nogent s/Marne (Seine), France.

Conférence Internationale des Arts Chimiques

The VI[e] Salon International de la Chimie and the Conférence Internationale des Arts Chimiques will be held from 25

April to 4 May 1962 at the Centre National des Industries et des Techniques, Rond-Point de la Défense, Puteaux, Paris.

Details of both may be obtained from the General Secretariat, 28, Rue Saint-Dominique, Paris VII[e].

DIARY

Powder Metallurgy Joint Group

17 and 18 April. Discussion on " The Appraisal of Powders for Pressing and Sintering " (Royal Commonwealth Society, Craven Street, near Northumberland Avenue, London, W.C.2.)

Local Sections and Associated Societies

6 April. Birmingham Local Section. Annual General Meeting. (College of Technology, Gosta Green, Birmingham, at 6.30 p.m.)

6 April. London Local Section. Annual General Meeting, followed by " Physical Methods of Analysis for Major Alloying Constituents ", by K. M. Bills. (17 Belgrave Square, London, S.W.1, at 6.0 p.m.)

11 April. Oxford Local Section. Annual General Meeting, followed by " Ductile Fracture ", by Professor R. W. K. Honeycombe. (Cadena Café, Cornmarket Street, Oxford, at 7.15 p.m.)

12 April. Leeds Metallurgical Society. " Some Aspects of the Metallurgy of Fasteners ", by R. J. Allsop. (University Staff House, University Road, Leeds, at 6.30 p.m.)

13 April. East Midlands Metallurgical Society. Annual General Meeting, followed by " Recent Work on Cold Forming and Extrusion ", by N. S. Angus. (Derby and District College of Art, at 7.30 p.m.)

20 April. Liverpool Metallurgical Society. " Continuous Casting of Aluminium Alloys ", by Dr. W. M. Doyle, followed by Annual General Meeting. (Department of Metallurgy, University of Liverpool, at 7.0 p.m.)

21 April. West of England Metallurgical Society. " Temperature Measurement ", by J. A. Hall. (The College of Technology, Ashley Down, Bristol 7, at 7.30 p.m.)

26 April. Southampton Metallurgical Society. " The Development of Cast Metals ", by Dr. H. T. Angus. Joint meeting with the Institute of British Foundrymen. (Southampton Technical College, at 7.15 p.m.)

APPOINTMENTS VACANT

Required for new Engineering Industry
located in Dublin

METALLURGIST: University graduate or L.I.M., to take control of most modern scientific equipment and manufacturing plant for the production of metallic alloys (mainly ferrous). Experience of X-Ray Spectrography desirable.

The man appointed will be required to carry out research on new alloys and processes.

Preferable age 25 to 35.

This is one of the most important new industrial ventures in Ireland and offers considerable prospects.

Salary will present no problem for suitable man.

Box No. 461, Institute of Metals, 17 Belgrave Square, London, S.W.1.

THE GLACIER METAL COMPANY LIMITED

who are the leading Company in the field of plain bearing development—require for their Research and Development Organization a

RESEARCH INVESTIGATOR.

He will be a member of a team developing recently established Company processes. He will design and execute experiments to study the metallurgy and the physics of these processes with a view to their simplification and will decide on the best operating procedures.

Applicants should be graduate Metallurgists or the equivalent. Alternatively, a graduate Physicist or Engineer with a knowledge of metallurgy would be suitable. Previous experience of industrial research or development work desirable.

Minimum age 23.

Salary in the range of £940–£1350 per annum.

Send brief details to
Personnel Division,
The Glacier Metal Co., Ltd.,
Alperton, Wembley, Middlesex.

quoting ref. HQPD/RI.

UNIVERSITY OF CAMBRIDGE

Applications are invited for a University Demonstratorship in Metallurgy: appointment will be from 1.10.61.

Applications close on 31.3.61.

Details of duties, salary, &c., may be obtained from Dr. F. B. Kipping, University Chemical Laboratory, Lensfield Road, Cambridge.

LANCHESTER COLLEGE OF TECHNOLOGY, COVENTRY

Principal:
A. J. Richmond, B.Sc.(Eng.), Ph.D., M.I.Mech.E.

SANDWICH COURSE IN METALLURGY

Applications are invited for admission to a THREE-YEAR Sandwich Course leading to the Higher National Diploma in Metallurgy and Licentiateship of the Institution of Metallurgists. Candidates should possess, or expect to obtain before September 1961:

(*a*) An Ordinary National Certificate in Chemistry or Metallurgy of sufficient merit;
(*b*) G.C.E. passes in English Language, Chemistry, Physics, Mathematics and one further non-science subject, of which either Chemistry *or* Physics *or* Mathematics must be at Advanced Level.

Industrial training is an integral part of the course for which both Works-based students and College-based students may be accepted. In the latter case, the College will be responsible for arranging industrial training, with pay, for suitably qualified applicants who can apply for a Local Authority award to cover the cost of maintenance and tuition during the periods of full-time study.

Full particulars of the course may be obtained from the Head of the Department of Chemistry, Metallurgy, and Textiles.

BATTERSEA COLLEGE OF TECHNOLOGY, LONDON, S.W.11.

Post-graduate courses in CRYSTALLOGRAPHY, consisting of one year full-time or two years part-time, will begin on 2 October 1961. These courses prepare for either the Internal degree of M.Sc. (Crystallography) of the University of London, or the College Post-Graduate Diploma (D.C.T. (Batt.)). Scholarships are available in certain circumstances. For further details apply to Dr. D. Lewis, Crystallography Section.